B.C. HYDRO

WHEELING POLICY

BY

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WHEELING COMMITTEE

Policy Development
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EXECUTIVE SUMMARY

Wheeling, in its simplest form, is the transmission of electric energy generated by one party to another using the transmission system of a third party. When the transmission system used is part of an integrated system including generation, this simple notion of wheeling does not occur. B.C. Hydro's Wheeling Policy reflects the fact that wheeling is complex with many parallel flows and involves the whole electric system rather than just transmission facilities.

B.C. Hydro has developed a unique policy and tariff for firm wheeling of electric power, utilizing its system, to loads within British Columbia. The objectives of this policy are to promote the efficient supply and distribution of electricity, encourage economic development, provide a wider market to non-utility generators and to be consistent with B.C. Hydro's sales rate structures.

B.C. Hydro's generation system predominantly consists of hydro plants and thus has the ability to store energy. From a generation point of view, energy is more critical than capacity. Since the main load centres are remote from generators, from a transmission perspective, capacity is more critical than energy. B.C. Hydro's unique approach to wheeling transactions treats capacity and energy in an independent fashion; capacity treatment is based on the impact on the system, while energy treatment recognizes the ability of B.C. Hydro's system for storage.

The supplier receives a Capacity Credit at the point where wheeling energy enters the system and pays a Demand Charge at the point where wheeled energy leaves the system. The Capacity Credit is differentiated by time of day, season, and region. The differentiation by time and region reflects the relative value of capacity with respect to time and in different geographical locations respectively. The Demand Charge is based on the applicable sales rate to the load. Short term wheeling contracts do not attract Capacity Credits as they will not have an impact on the system plan. They are charged for an opportunity cost related to the amount of energy wheeled to compensate B.C. Hydro for short term revenue losses from existing or planned facilities.

A wheeling commission of 0.1¢/kW.h applies to all wheeled energy to compensate B.C. Hydro for operation, maintenance and administration costs. The charge for system losses is based on wheeled energy and system voltage level at the point of delivery. At the end of each billing period, an energy balance is computed based on the energy supplied by the source, the energy consumed by the load, and losses. B.C. Hydro, with its system's ability to store energy, balances any load requirements within ±3% of the nominated wheeling energy. Once the band of ±3% is exceeded, all energy is sold, or bought from, B.C. Hydro at the POWEREX Pool Operation monthly Buy and Sell prices (a concept currently under development).

This policy encourages favourable location of future power supply facilities. It gives the correct price signals and will facilitate the development of an efficient bulk power market in B.C. It uses B.C. Hydro's unique hydro-based system characteristics to enhance the value of power generated by non-utility generators by providing shaping, storage, increased reliability and backup. It provides unrestricted system access without causing undue degradation of system reliability or adverse economic impact on B.C. Hydro's customers.

WHEELING POLICY

1.0 INTRODUCTION

Wheeling is the transmission of electric energy generated by one party to another using the transmission system of a third party, referred to as the wheeler. The wheeler accepts electric power at one point on its transmission system and delivers it at another point on the system. The wheeler does not own, generate or purchase the electricity being transported from one point to another. It only "wheels" it by allowing the use of its electric system.

Competition in the generation side of the electric utility business is increasing and is expected to be beneficial to consumers and the economy in general. The primary reasons for the expansion of this competition are the emergence of non-utility generators, and the recent establishment of request for proposals to supply electric utility generation requirements on a bidding system. The increase in the competitive bidding process, the desire on the part of large industrial users to purchase directly from producers, and an increase in cogeneration and resulting surplus power generated by large industrial processors, have all contributed to the increasing demand for access to, and use of existing and future transmission facilities of electric utility systems.

B.C. Hydro supports the concepts of competition and efficiency in the generation of electricity and has introduced competitive bidding for future generation requirements for both domestic and export markets. In developing a wheeling policy, B.C. Hydro recognizes that access to the B.C. Hydro integrated system is vital for the promotion of the efficient supply and distribution of electricity in British Columbia. B.C. Hydro's Wheeling Policy addresses impacts of wheeling transactions on the system and provides product enhancement to non-utility generators. It also provides more supply options to electricity consumers, and a wider market for suppliers, in British Columbia.

An application for approval of the Wheeling Policy and Tariff is expected to be submitted to the British Columbia Utilities Commission by April 1990.

2.0 POLICY DEVELOPMENT

Development of the policy involved resolving competing objectives with respect to efficiency of supply and load; quality, reliability and security of supply; and the interests of B.C. Hydro's customers, non-utility generators, and the provincial government.

2.1 Wheeling Committee

A Wheeling Committee was established in late 1988 with representatives from B.C. Hydro's Planning, Operations, Policy Development and Customer Service Departments and from the Ministry of Energy, Mines and Petroleum Resources of British Columbia. The committee developed wheeling service issues, guidelines, objectives and procedures for development of a wheeling tariff and a generic wheeling service agreement. The committee used a decision analysis technique to develop the policy, which was then presented to various parties to critique and was further modified.

2.2 Policy Objectives

The policy development process took into account the perspectives of the government and B.C. Hydro, and the needs of non-utility generators and electricity consumers in British Columbia. The policy was primarily designed to achieve the following objectives:

a) Increase the efficient use of the total interconnected system in British Columbia. The total interconnected system includes B.C. Hydro's system, non-utility systems, and the neighbouring utilities' systems.

b) Encourage the orderly and efficient development of electricity generation and loads in British Columbia.

c) Provide guidelines for development of wheeling rates that give the correct price signals. That is, rates that encourage efficient use and development of the electric system in preferred supply locations and that are consistent with B.C. Hydro's sales rate structures.

d) Provide net benefits to B.C. Hydro's customers and be neutral with respect to the quality of supply.

2.3 System Characteristics and Considerations

B.C. Hydro's generation system predominantly consists of hydro plants and thus has the ability to store energy. Most of this generation is located remotely from the major load centres. From a generation point of view, energy is more critical than capacity. However, from a transmission perspective, capacity is more critical. The policy development approach to wheeling transactions treats capacity and energy in an independent fashion. That is, treatment of capacity is based on the impact on the system, while energy treatment is based on B.C. Hydro's system ability for storage.

The characteristics of interconnected transmission networks are such that a wheeling transaction involves the total interconnected system, not just the portion connected directly between the source and the load. Each wheeling transaction impacts on the network in a unique way, depending on the time of wheeling, the location of supply source and load, and may even impact neighbouring utilities' systems. Any approach that views a wheeling transaction simply as a flow of electrical energy directly from the source to the load in a large interconnected network, ignores parallel system load flows and associated impacts.

3.0 POLICY CHARACTERISTICS

The policy takes a long term view of electricity supply and use, and the economic development of British Columbia. It is wide in its scope and application.

3.1 Availability

B.C. Hydro will offer wheeling service to any party for the purpose of serving a load within British Columbia. There are no supply size or location

restrictions. There are no restrictions on load as long as it is located within British Columbia. The rates, however, reflect the fact that the system value of capacity is a function of location.

The intent of the policy is to encourage efficiency. Consumers with self-generation are encouraged to utilize self-generation for their own load. B.C. Hydro will only wheel customer-generated energy that is in excess of the customers own requirements.

3.2 Firm Wheeling

B.C. Hydro will make uninterrupted system capacity available for firm wheeling of energy on a long term basis. The service will be interrupted only for safety reasons or under extreme electric system operating conditions. System plans will accommodate future wheeling needs as long as the required lead time is given and a long term contract to wheel in the future is in place.

3.3 Length of Service

This policy is designed to apply to wheeling transactions with a duration of at least one year. Wheeling service arrangements affecting the electric system capacity plans and operations must specify the scheduled wheeling requirements in detail at the time of agreement. This ensures that capacity is made available on the system to meet immediate and future transmission requirements.

Very short term wheeling transactions, that is, wheeling service for a duration of less than one year, are subject to existing system capacity and specific operating conditions at the time service is desired. Therefore, very short term wheeling transactions impose different system and opportunity costs on the wheeling utility. To ensure that these costs are reflected reasonably in the wheeling service price, very short term wheeling service will be made available through POWEREX Pool Operation, a concept that is currently under development.

3.4 Wheeling Nomination and Schedule

Long term system planning,installation and operation of facilities requires information on system loads. Therefore, each wheeling service customer is required to nominate a monthly energy quantity and the expected hourly output of generation or energy sources connected to the system. For reliable and economic system operation on a daily basis, the supplier is also required to submit an expected hourly generation schedule for a typical weekday and weekend for each month.

4.0 GENERAL WHEELING SERVICE RATE

The General Wheeling Service rate schedule has five components. These are Wheeling Commission Charge, Energy Losses, Opportunity Costs, Demand Charge and Capacity Credit. The rate structure makes a clear distinction between capacity and energy. Capacity is treated as a credit

to the system at the point of entry. A Demand Charge is levied at the point of use.

4.1 Wheeling Commission Charge

A Wheeling Commission Charge of 0.1¢/kW.h applies to all wheeled energy. This is designed to recover the cost of administration, operation and maintenance. There is a minimum cost to all wheeling transactions regardless of the amount of energy wheeled. In order to recover this cost the Annual Minimum Wheeling Commission Charge is set at $3600.

4.2 Energy Delivery Charge

Wheeling agreements with terms greater than one year, but less than ten years are considered short term in the sense that these agreements will not affect system development plans. Anything longer is considered long term. There is an Energy Delivery Charge that applies to short term wheeled energy. This charge is designed to compensate B.C. Hydro for short term revenue losses and opportunity costs for existing and planned facilities. Shorter term wheeling services leave stranded investment that will not be used up by growth in sales in the short term. In the long term, wheeling service will defer the need to build plants. This results in marginal cost savings that are increasing with time. After 1994, these cost savings equal or exceed the revenue losses and opportunity costs. Therefore, the Energy Delivery Charge is set to zero. It may also be appropriate to treat wheeling service in a fashion similar to demand side management and thus no Energy Delivery Charges for long term wheeling.

4.3 Energy Losses

There are losses associated with wheeling energy over the system. These losses are a function of B.C. Hydro's system voltages at the supply and load interconnection points. To keep the rate schedule simple, average system energy losses are used and expressed as a percentage of wheeled energy by delivery point voltage, as shown in Table 1.

The rate schedule is designed to recover losses on wheeled energy based on B.C. Hydro's system voltage at the point of delivery. Energy losses are accounted for in the Energy Balancing at the end of each billing period.

4.4 Energy Balancing

The system capacity provided by B.C. Hydro is for the quantity of energy to be wheeled as nominated in the agreement. However, a wheeling energy source can wheel less, and the load can consume more or less, than the energy quantity nominated. Where the energy wheeled is less than the load to be met by the nominated energy for the period, B.C. Hydro will sell energy to meet the load requirements. On the other hand, where the wheeled energy exceeds the load to be met by nominated energy, B.C. Hydro will purchase excess energy. The Buy and Sell prices will be the monthly POWEREX Pool Operation Buy and Sell prices.

The rate structure includes provisions for shaping, storage, increased reliability and backup of wheeled energy. The rate structure is designed to provide some flexibility and discipline for wheeling arrangements through Energy Balancing. Any energy requirements within ±3% of the nominated energy quantity to be supplied will be balanced by B.C. Hydro. A logic chart for Energy Balancing is shown in Figure 1.

Deemed wheeled energy is defined as the lesser of the nominated energy and the energy consumed for the period. Any consumption that exceeds the nominated energy is supplied by B.C. Hydro at its standard rates. Energy delivered is the energy supplied by the wheeling source, less losses. Credit energy is the lesser of the delivered energy and the nominated energy. If credit energy is deficient or exceeds the sum of the deemed wheeled energy plus the energy balance from the previous period by the band of absolute 3% of the nominated energy, then all of the out of balance energy is sold to, or bought from, B.C. Hydro and the Energy Balance carried over to the next month is set at zero. Any out of balance energy within the absolute 3% is carried to the next billing period.

If the credit energy exceeds, by 3% or more of nomination for the period, the sum of the deemed wheeled energy, and the Energy Balance from the previous period, then all of credit energy that exceeds this sum will be sold to B.C. Hydro. The selling price will be the POWEREX Pool Operation Buy price for the period. The Energy Balance carried over to the next month will be zero. If the excess is less than 3% of the nomination for the period, then all excess energy is the Energy Balance that is carried over to the next month, and no energy is sold to B.C. Hydro.

On the other hand, if the sum of the deemed wheeled energy and the Energy Balance from the last month exceeds the credit energy by more than 3% of the nomination for the period, then all of the deficit will be supplied by B.C. Hydro at the POWEREX Power Pool Sell price. The Energy Balance carried over to the next month will be set to zero. If the credit energy is deficient in meeting the sum of the deemed wheeled energy plus the Energy Balance carried over from the previous period, but the deficiency is less than 3% of the nomination, then the deficiency is carried over to the next month.

4.5 Capacity Credit

Long term wheeling customers receive a Capacity Credit at the point where wheeling energy enters the B.C. Hydro system and are charged a Demand Charge at the delivery point. Capacity Credit is differentiated by time of day, season, year and region. Total Capacity Credit is the sum of estimated cost savings of additional capacity in generation, area transmission, and system transmission. Total credit is multiplied by a monthly weighting factor that reflects the seasonal value of capacity to B.C. Hydro's system.

Short term wheeling transactions, that is, agreements with terms greater than one year but less than ten years, do not attract a Capacity Credit because there is very little to no impact on the system long term plans.

4.5.1 Generation Credit

The Generation Credit of $0.50/kW/month for all supply prior to 1 April 1999 and $2.00/kW/month thereafter, recognizes the value of system generation capacity as derived from the B.C. Hydro Generation Resource Plan. The credit is set at a lower level for the period prior to 1999 to reflect B.C. Hydro's current generation sequence; which reflects the expected load resource balance over the planning period.

4.5.2 Area Transmission Credit

The Area Transmission Credit is set at $0.80/kW/month. This credit is for recognition that wheeling energy reduces the area transmission demands placed on the system by having wheeling energy sources closer to the load and at different points on the system. Area transmission supplies are at voltages less than 500 kV. If the wheeling supply interconnection point is to a utility intertie or is at or greater than 500 kV, the Area Transmission Credit does not apply, nor does it apply to interconnections from outside B.C. Hydro's service area, as it does not result in cost savings in area transmission.

4.5.3 Major System Transmission Credit

The Major System Transmission Credit varies by the region of the interconnection point. This credit reflects the cost saving a wheeling supply source will have on system transmission. Most of B.C.'s load growth is occurring in the Lower Mainland and Vancouver Island regions, while most of B.C. Hydro's future generation resources will be located in the south eastern or northern part of the province, as shown in Figure 2. Wheeling supply sources located in the southwestern part of the province result in much larger savings in system transmission costs than sources located in the northern or eastern parts. To recognize the regional transmission cost saving differences, the transmission system is divided into 10 regions and the credit, in $/kW/month, is set for each region as shown in Figure 3.

4.5.4 Capacity Credit Monthly Weighting Factors

As with all electric utilities, in addition to varying by region, the value of capacity provided to B.C. Hydro's system varies by time-of-day and season. Since B.C. Hydro is winter peaking, the capacity provided in the winter months is more valuable than in the summer months. Likewise, capacity provided during heavy load hours is much more useful than that provided during light load hours. Heavy load hours are from the hours 0700 to 2000 on a typical weekday. In order to recognize this variation in value of capacity provided by a supply source, the Capacity Credit is time of day and season differentiated. The Capacity Credit applies to the capacity supplied during the heavy load hours on a weekday and is adjusted by the Monthly Weighting Factors, shown in Table 2.

4.6 Wheeling Demand Charge

The Wheeling Demand Charge was designed such that the load consuming wheeled energy is charged a Demand Charge that is compatible with the Demand Charge for B.C. Hydro's sales customers in the same location. It is the same as the sales rate applicable to the load. The Demand Charge includes recovery of the cost of shaping, storage and standby costs.

5.0 TERMS AND CONDITIONS

The Terms and Conditions of service, both contractual and technical, are covered in detail in a Wheeling Agreement. Some of the important aspects of a Wheeling Agreement are:

- All interconnection costs and any enforcements or modifications to B.C. Hydro's system are treated in a manner similar to a sales customer on the load side and as an IPP on the supply side.

- Both the load and the source must fulfil their wheeling commitments before participating in other buying or selling transactions with B.C. Hydro, POWEREX, or POWEREX Pool Operation.

- Where the source or load consuming wheeling energy have more than one wheeling or sales agreements, they must be prioritized.

- A wheeling source must provide an hourly generation schedule for a typical weekday and weekend for each month.

- A performance bond will be required.

- Wheeling service will be subject to interruption or curtailment due to emergency operating conditions.

- Wheeling from plants in operation prior to 1990 will attract capacity credit that are no greater than the Demand Charges applicable to the load served.

- B.C. Hydro will only wheel customer-generated energy that is in excess of the customers own requirements.

6.0 POLICY ANALYSIS IMPACT

The Policy is designed to facilitate the development of efficient electricity supply and loads in British Columbia. It provides independent power producers access to all existing and new customers in British Columbia; and provides British Columbia's electricity consumers with a choice of suppliers. The Policy is open to all locations, sizes and types of customers and loads. There is consensus that the enhanced access by suppliers to the loads and by loads to suppliers provided by this Policy will result in competition that will encourage efficiency of supply of electricity in British Columbia.

The Policy takes advantage of the unique characteristics of B.C. Hydro's system to enhance the value of energy supplied by non-utility generators. It provides storage and capacity upgrades and thus allows the wheeling sources flexibility in their operation; and allows customers served by the

wheeling sources the same quality of supply as B.C. Hydro's sales customers.

The Policy provides an opportunity for customers with their own generation to wheel to any of their plants within British Columbia and thus become self sufficient.

The Policy and the rate structure are designed to benefit B.C. Hydro's customers by the efficient use of the system and are neutral with respect to quality of supply. The rate is designed to recover the full cost of making wheeling service available. The terms and conditions of wheeling service are such that there is no undue degradation of system reliability.

The proposed wheeling rate structure fails to achieve the optimum load location price signalling objective. This is due to the desire to keep wheeling rates and sales rates compatible and due to the existing postage stamp sales rate structure. The sales rate structure is under review and is expected to move towards providing optimum load location signalling by the end of 1990. Since the wheeling Demand Charge is derived directly from the sales rate applicable to the load, the restructured sales rates will provide price signals that will help in achieving the optimum load location objective.

The Policy encourages orderly and efficient economic development in the province. The rate structure provides price signals that encourage supply locations in the desired areas of the province. The Policy facilitates competition in the generation and supply of electricity in British Columbia which is expected to result in lower cost to consumers. The additional generation will also allow B.C. Hydro to postpone building future generation plants and reduce future costs to British Columbians at large.

7.0 CONCLUSION

The objectives of the Wheeling Policy are to promote the efficient supply and distribution of electricity, encourage economic development, provide a wider market to non-utility generators and be consistent with B.C. Hydro's sales rate structures. The resultant General Wheeling Service rate structure and Terms and Conditions of service reasonably meet these objectives by providing the right price signals for favourable location of wheeling sources; by using B.C. Hydro's unique hydro-based system characteristics to enhance the value of power generated by non-utility generators in the form of shaping, storage, increased reliability and backup; and by providing unrestricted system access without causing any undue degradation of system reliability or adverse economic impacts on B.C. Hydro's customers. The Policy, however, fails to achieve the objective of encouraging optimum load location at this time. This will be addressed in B.C. Hydro's planned sales rate restructuring expected at the end of 1990.

The concept used to arrive at this Policy is unique and will be put to the test over a two year period. The Policy will be modified with practical experience. An application for approval of the Wheeling Policy and Tariff is expected to be submitted to the British Columbia Utilities Commission by April 1990.

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Energy Balancing

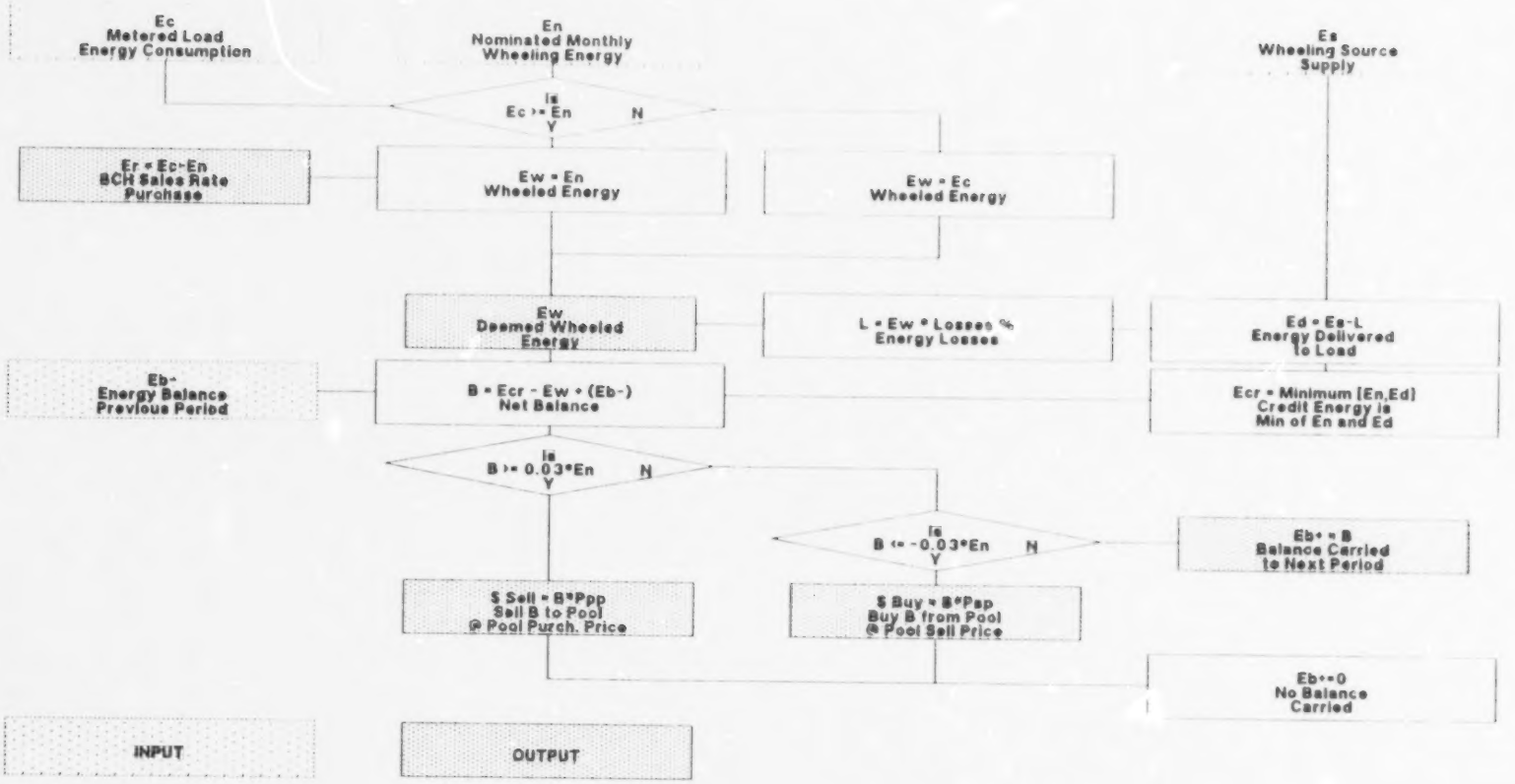
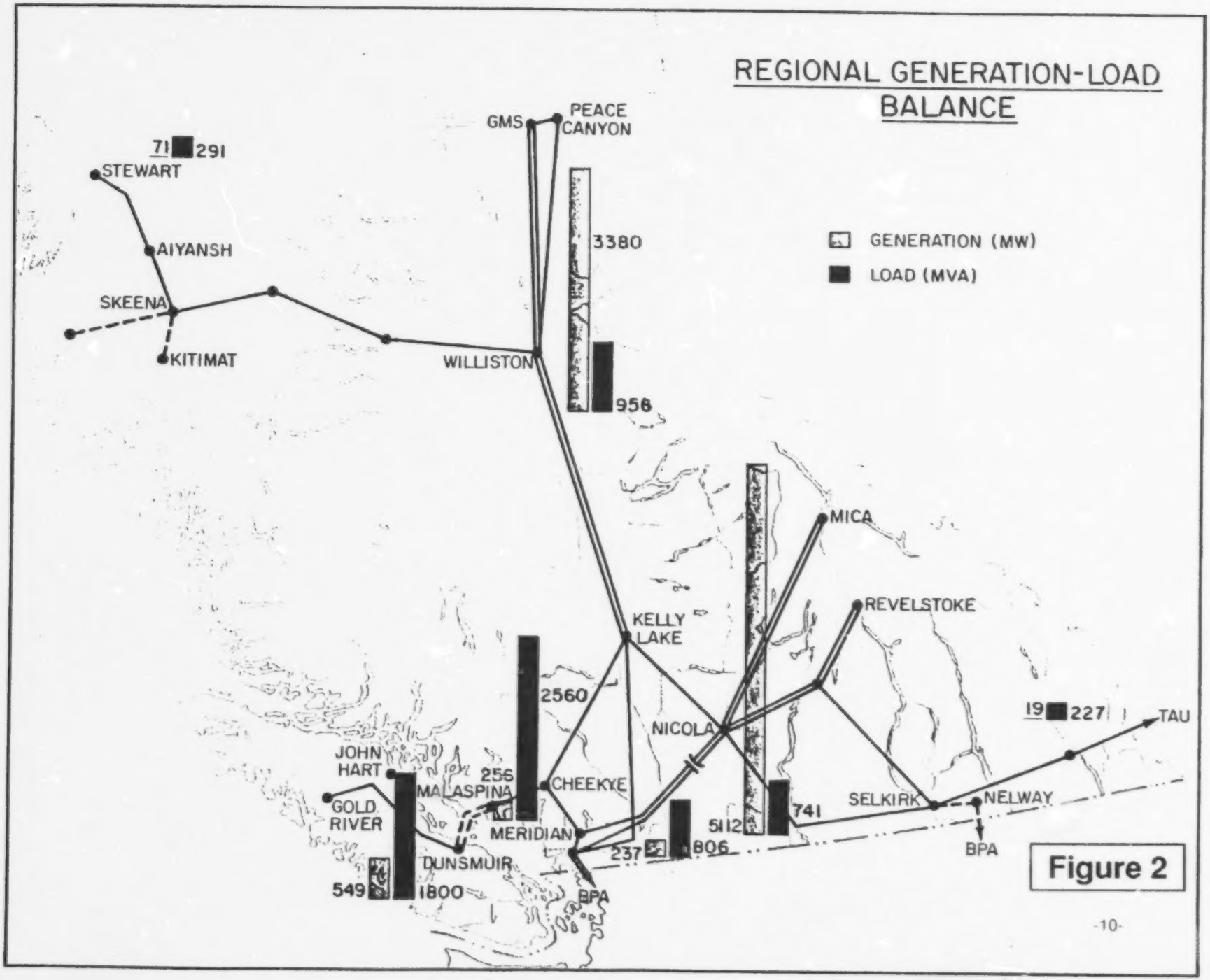


Figure 1


REGIONAL GENERATION-LOAD BALANCE
GENERATION (MW)
LOAD (MVA)
GMS
PEACE CANYON
3380
956
71
291
STEWART
AIYANSH
SKEENA
KITIMAT
WILLISTON
MICA
REVELSTOKE
KELLY LAKE
2560
NICOLA
19
227
TAU
JOHN HART
256
ASPINA
CHEEKYE
GOLD RIVER
MERIDIAN
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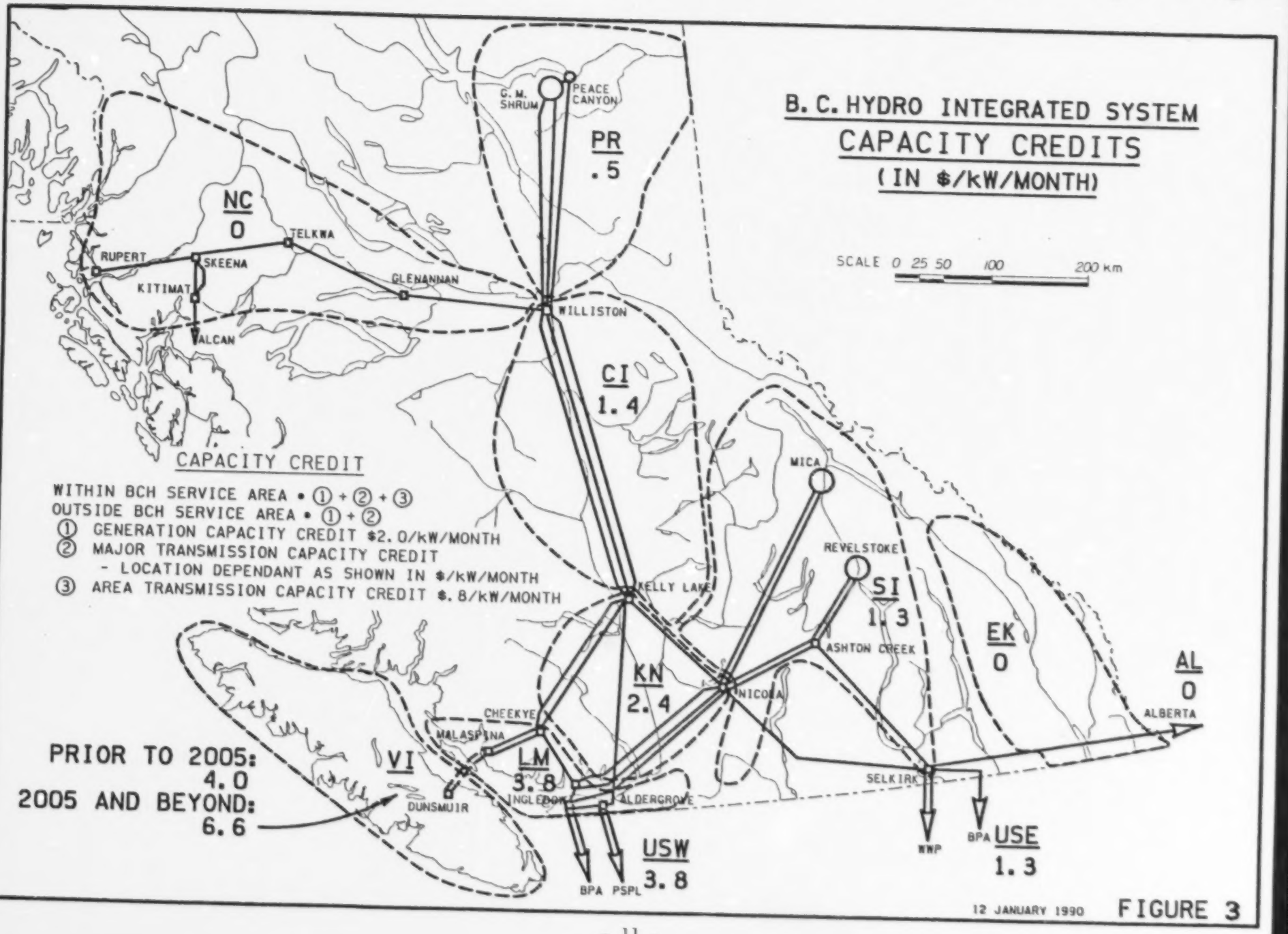
549
1800
BPA

Figure 2



12 JANUARY 1990 FIGURE 3

Table 1

Energy Losses

Nominal System Voltage	Average Losses
≥ 500 kV	4.0%
≥ 138 but < 500 kV	6.0%
< 138 kV	9.5%

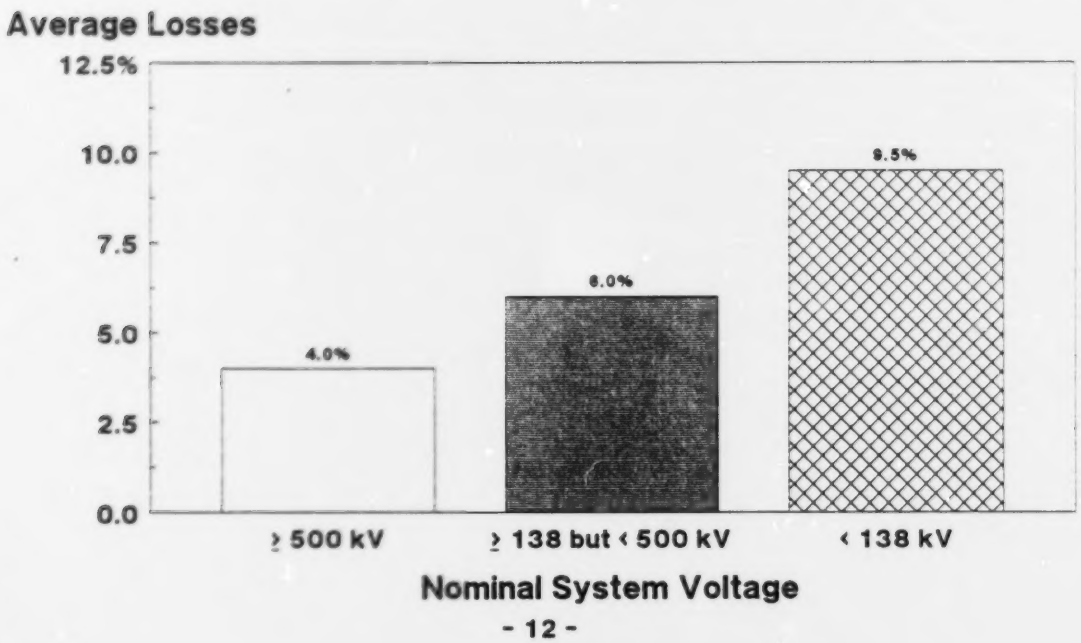


Table 2

Capacity Credit
Monthly Weighting Factors

Month	Weighting Factor
January	1.5
February	1.5
March	1.0
April	1.0
May	0.5
June	0.5
July	0.5
August	0.5
September	1.0
October	1.0
November	1.5
December	1.5

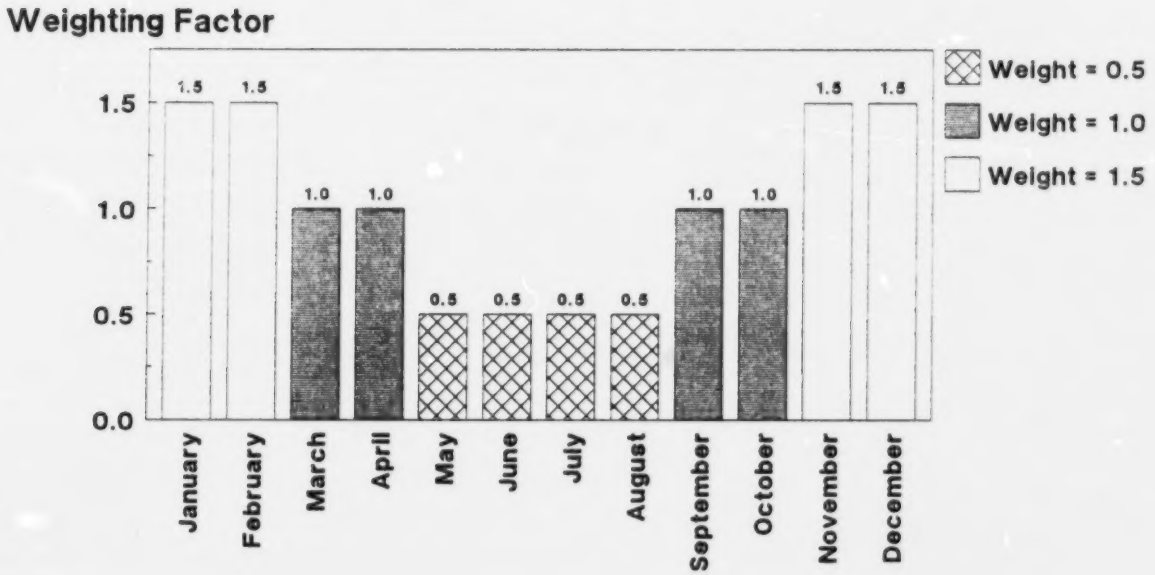
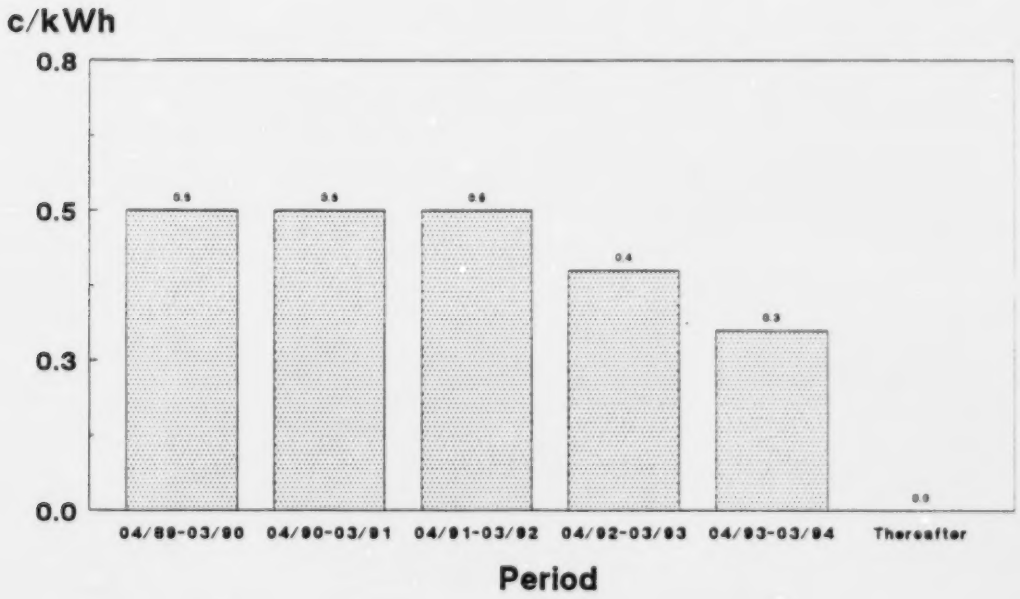


Table 3

Energy Delivery Charges

Period	Cents/kWh
04/89-03/90	0.5
04/90-03/91	0.5
04/91-03/92	0.5
04/92-03/93	0.4
04/93-03/94	0.3
Thereafter	0.0



POWEREX Pool Operation
EXECUTIVE SUMMARY

POWEREX Pool Operation (PPO) is part of the British Columbia Power Export Corporation (POWEREX). It is a marketing operation that will serve the short term bulk electricity markets within and outside of British Columbia, including Alberta and the Western United States. The PPO will facilitate short term electricity transactions to realize competitive opportunities and efficiency gains in the open bulk power market for the benefit of British Columbia. Short term transactions are any electricity transactions with a duration of less than one year.

The PPO will utilize B.C. Hydro's reservoirs and electric system to store and transmit electricity for bulk producers and to bulk users. It will use POWEREX's power marketing "know how" to facilitate short term transactions. The PPO will operate as an effective market maker in a deregulated "open access" environment. The PPO activities will include buying, selling, storing, lending, exchanging and wheeling of short term electricity and other related services.

The objectives of the PPO are to maximize the return to British Columbia from short term electricity exchanges, create an active short term electricity market, provide expanded access to all electricity trade customers and to enhance the value of electricity surplus from non-utility generators.

The PPO will post hourly, monthly and longer term buy and sell prices and quantities based on market conditions. A supplier will also have the option of nominating a selling price to the PPO. The PPO may require the supplier to base the nominated price on the supplier's incremental production cost. The charge for wheeling of electricity is based on a charge for border crossing tie lines and a charge for wheeling within the province on B.C. Hydro's system. The charge for storage, paid at the time of return of stored energy, is based on posted energy buy and sell prices at the times of storage and return. The PPO posted short term capacity prices will be time, region and duration differentiated to reflect the value of capacity.

The PPO will facilitate increased trade in the bulk short term electricity markets by meeting varying degrees of market supply and demand requirements. The value of energy produced by IPPs will be enhanced by the PPO providing storage, backup and shaping. Storage and lending of energy will provide opportunities to capitalize on the best market conditions and provide flexibility to IPPs in their operation by pooling resources to meet the specific needs of producers and users.

Consultants reviewed the PPO concepts and advised that "The PPO and its proposed operation is consistent with the emerging direction towards increased competitiveness in North American power markets. It has unique features such as its unbundled storage and market based pricing mechanisms which are expected to contribute to efficiency in the bulk power markets.".

If you want further information on this operation, please contact:
Dr. Zak El-Ramly, VP, Development (663-3277)

BRITISH COLUMBIA POWER EXPORT CORPORATION • Suite 3450, 666 Burrard Street • P.O. Box 3308, Vancouver, B.C. V6B 5K6 • (604) 663-3660 Fax (604) 663-3644